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Total number of authors:
24

Publication date:
2015

Document Version
Peer reviewed version

[Link back to DTU Orbit](#)

Citation (APA):

Chen, Y., Trier, F., Wijnands, T., Green, R. J., Gauquelin, N., Egoavil, R., Christensen, D. V., Koster, G., Huijben, M., Bovet, N., Macke, S., He, F., Sutarto, R., Sulpizio, J. A., Honig, M., Prawiroatmodjo, G. E. D. K., Jespersen, T. S., Linderoth, S., Ilani, S., ... Pryds, N. (2015). *Extreme mobility enhancement of two-dimensional electron gases at oxide interfaces via charge transfer induced modulation doping*. Poster session presented at E-MRS 2015 Fall meeting, Warsaw, Poland.

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Extreme mobility enhancement of two-dimensional electron gases at oxide interfaces via charge transfer induced modulation doping

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□ Motivation:

To suppress the localized or impurity charge carriers at the interface of SrTiO₃-based 2DEGs by introducing an electron sink. Perovskite manganites are good candidates due to the good lattice match with STO and the presence of empty or partially-filled band lower than that of STO.

□ Metallic oxide interfaces with extremely-high electron mobility and controllable carrier density

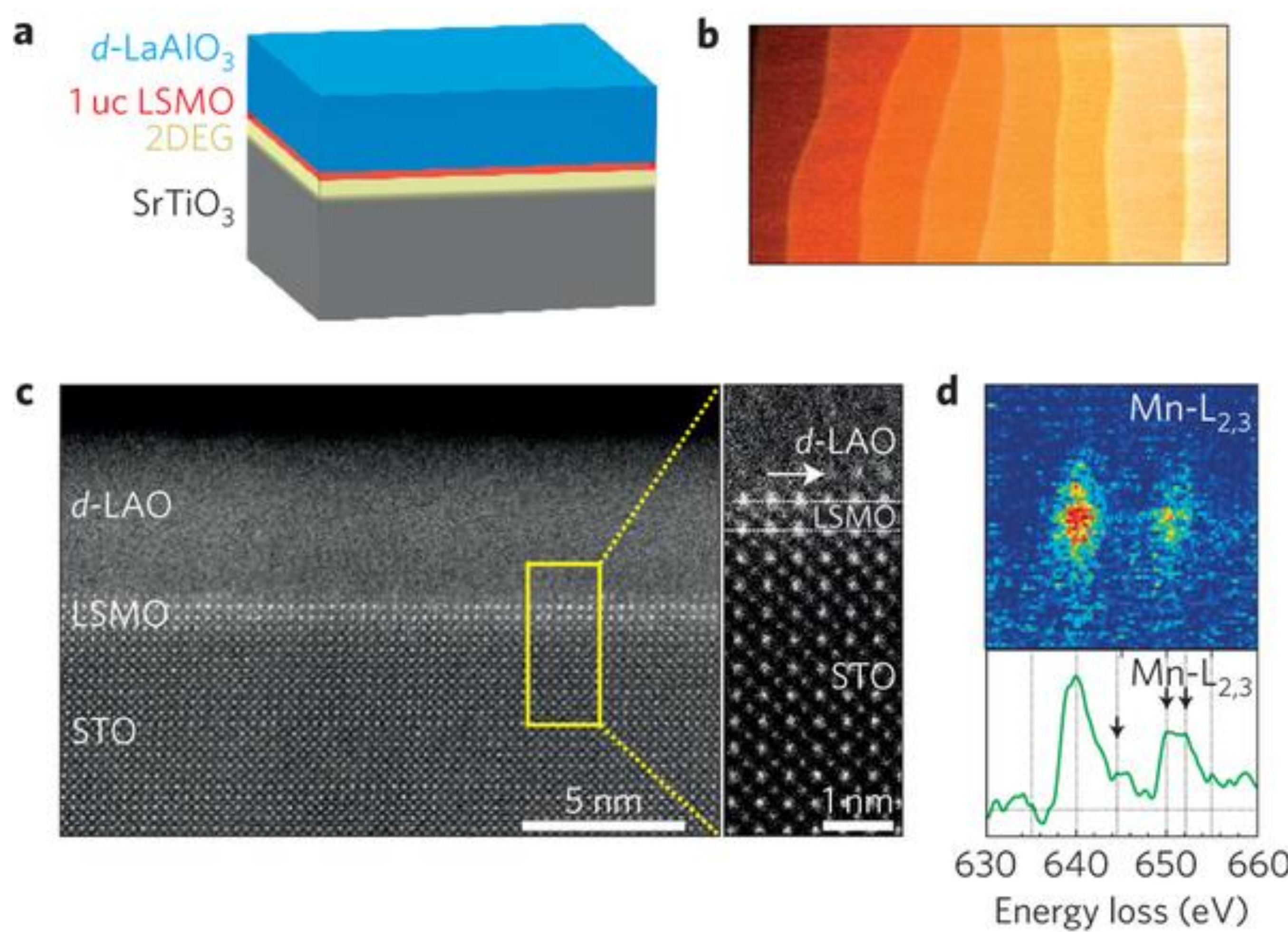


Fig. 1. Oxide interfaces with a single-unit-cell manganite buffer layer

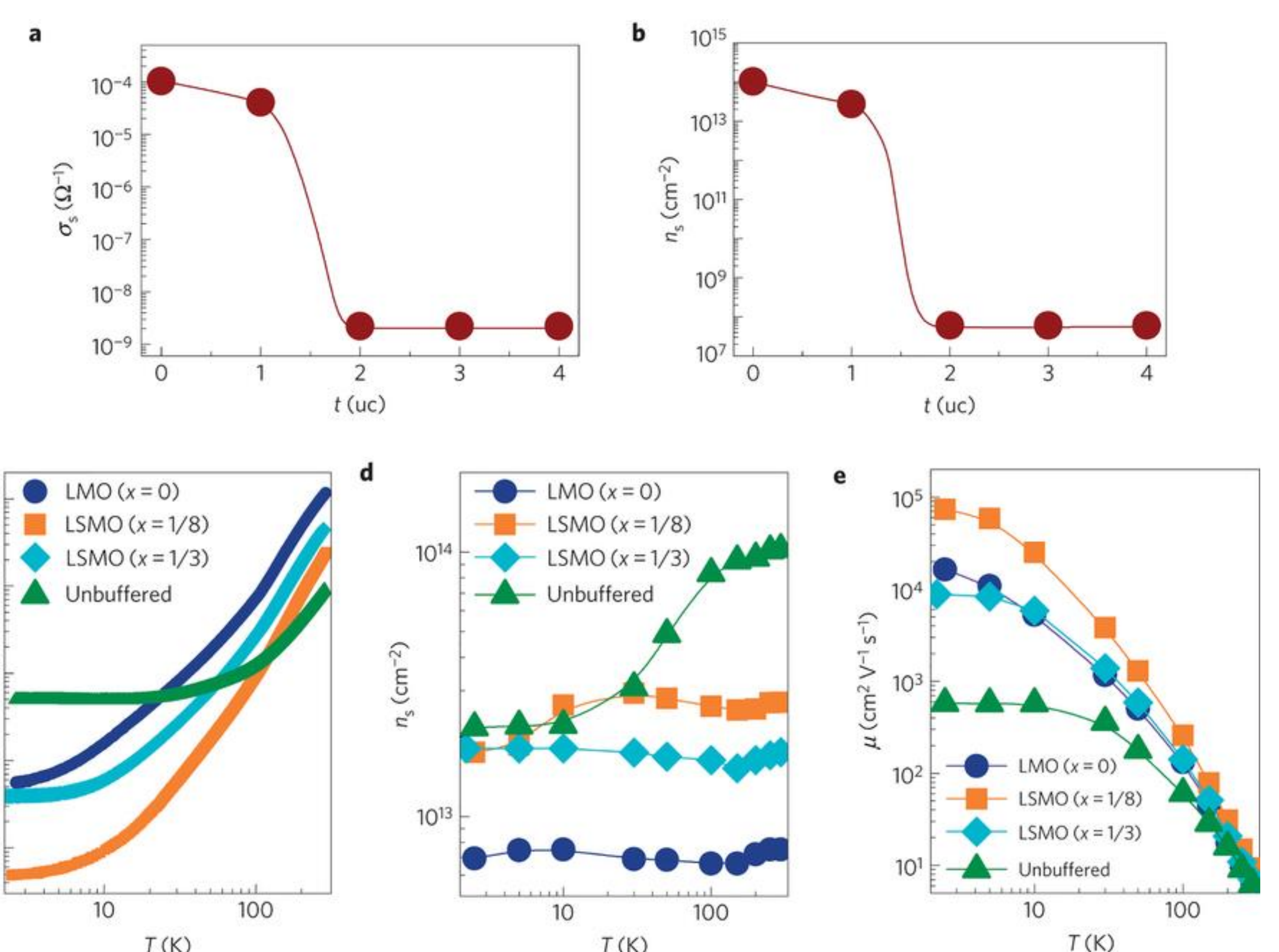


Fig.2. Electronic properties of buffered heterostructures

□ Charge transfer induced modulation-doping at oxide interfaces

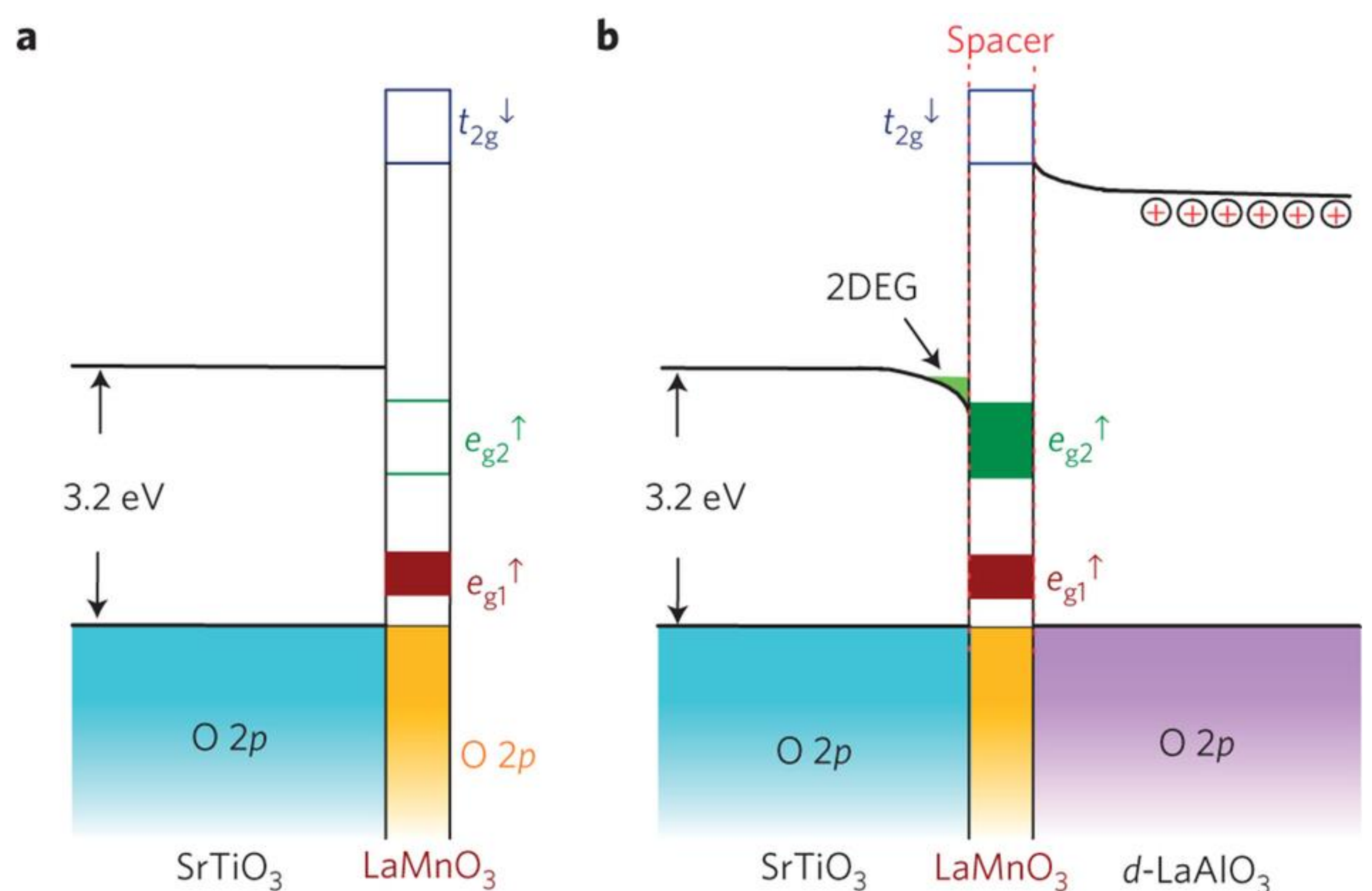
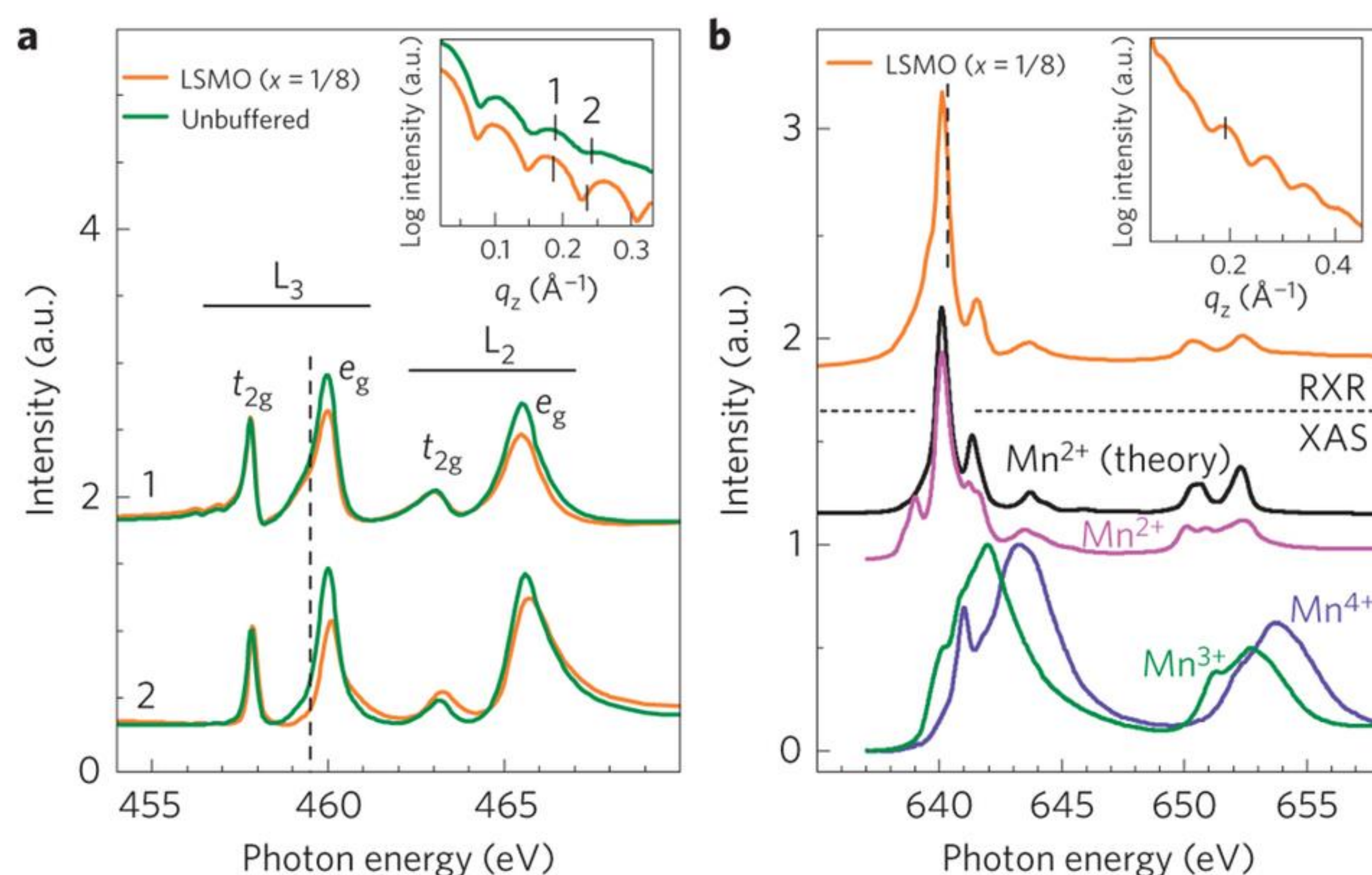


Fig.3. Electronic reconstructions determined by resonant X-ray reflectivity. Fig. 4 Schematic band diagram of LMO/STO and buffered d-LAO/STO

□ Conclusion

The manganite spacer suppresses strongly the formation of oxygen vacancies on the STO side and leads to modulation-doping at the buffered oxide interface. At low temperatures, the modulation-doped 2DEG exhibits clear Shubnikov-de Haas oscillations and clear quantum Hall effect.

1) Y. Z. Chen *et al.* *Nano Lett.*, **11**, 3774-3778 (2011); 2) Y. Z. Chen *et al.* *Nature Mater.* **14**, 801-806 (2015)

3) **News story: Clean up metallic oxide interfaces** (nanotechweb.org)